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ABSTRACT

The Effects of Local Market Concentration and International Competition on Firm Productivity: Evidence from Mexico*

Although market concentration is one of the main impediments to productivity growth globally, data constraints have limited its analysis to developed countries or cross-country studies based on definitions of market concentration across nations and industries. This paper takes advantage of a database that is unusual by developing-country standards by means of leveraging the richness of five rounds of the Mexican Manufacturing Census between 1994 and 2014. The data allow estimation of the effects of local industry concentration on productivity. The main results show that a decline by 10 points in the Herfindahl-Hirschman index (on a 0-100 scale), a measure of market concentration, explains an increase by 1 percent in the total factor productivity of revenue. Local industry concentration also has heterogeneous effects on productivity across industries, while its impact on productivity varies by level of exposure to international markets. Results show that the effect of greater exposure to trade offsets and, in most cases, reverses the negative effects of local concentration on productivity. These results are robust to specifications based on the estimation of firm productivity using the panels of establishment data from the 2009 and 2014 rounds of the economic census, to controlling for a proxy of markups, and to using alternative indicators of local industry concentration.

JEL Classification: C26, D24, D4, F12, L1

Keywords: productivity, market concentration, instrumental variables

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1. Introduction

The promise of income convergence between developing and developed countries has been lost in what has been called the middle-income trap (Garrett 2004). Despite substantial investment, improvements in human capital, and the demographic dividend, most middle-income countries have not been able to catch up with developed economies. Most studies have concluded that the main factor behind the lack of sustained income growth in developing countries has been stagnant productivity growth (OECD 2014). The economic literature has identified many factors associated with patterns of low productivity growth. These include the business environment, factor misallocation, fiscal policy, human capital, and market structure. Among these and other determinants, Cusolito and Maloney (2018) use enterprise survey data to show that product market competition is by far the largest contributor to variations in the dispersion of the total factor productivity (TFP) of revenue. Competition is critical because it promotes greater productivity within firms and a better allocation of resources across firms (CAF 2019). Most studies that have examined the links between competition and productivity have focused on cross-country analysis of aggregate productivity growth or have defined market concentration in terms of nations or industries. With a few exceptions in developed economies and specific industries, this research question has garnered little attention in developing countries, especially because of the lack of adequate data to study the phenomenon rigorously (De Loecker 2011; Dunne, Klimek, and Schmitz 2008; Nickell 1996; Schmitz 2005).

This paper explores the links between market concentration and productivity in the manufacturing sector in Mexico. It accounts explicitly for the joint effect of local market concentration and trade exposure. Mexico is an emblematic case-study given the large market reforms implemented there that sought to liberalize the economy and open it to foreign trade (Levy 2018; López-Córdova and Rebolledo 2016; World Bank 2018). If productivity in Mexico had kept pace with productivity in developing economies, relative income per capita would have been 24 percent higher in Mexico in 2008 relative to 1960 (Busso, Fazio, and Levy 2012). Although it has one of the largest numbers of trade agreements of any country, Mexico lags among members of the Organisation for Economic Co-operation and Development (OECD) in product market competition indicators, the cost of market entry for new firms, and levels of markup (CAF 2019; Conway, Janod, and Nicoletti 2005).

The analysis here takes advantage of firm-level census data for 20 years to study the extent to which local industry concentration explains the stagnation in productivity growth in the manufacturing sector in Mexico. Long-term trends in local industry concentration are illustrated using a Herfindahl-Hirschman index (HHI) at the 3-digit sectoral level across 54 metropolitan areas. The analysis estimates a linear model at the firm level using five rounds of the economic census in Mexico (1994, 1999, 2004, 2009, and 2014). To address potential endogeneity concerns about the relationship between local market competition and firm-level productivity, the analysis is based on an instrumental variable approach strategy following a Bartik (1991) procedure. The instrument produces a counterfactual industry concentration index for each metropolitan region by applying national changes to a 3-digit sectoral concentration for each industry, using each metropolitan area industry concentration index from the 1994 economic census as the base year. The identification assumption implies that changes in the 3-digit industry concentration at the national level impact firm-level productivity only through the effect on the variation in local market concentration in the same industry. By design, the instrument cannot be influenced by selection into metropolitan areas; rather, it isolates the component of change in the local concentration that is driven by national trends, such as changes in national policies or in industry-specific incentives.

Estimates based on the preferred model show that a decline in local industry concentration by 10 points measured by the HHI (on a 0–100 scale) explains a rise by 1 percent in the TFP of revenue. These results are robust to other measures of concentration, such as the revenue share of the five largest firms within a metropolitan area. Local industry concentration has heterogeneous effects across industries. The results reveal a negative and statistically significant impact of concentration on productivity in 10 of 20 subsectors.

A key finding in the context of Mexico is that exposure to trade reverses the negative effects of local concentration on firm productivity. The results show that the negative effects of greater market concentration on productivity are neutralized among local firms that are more exposed to international markets, implying that the relevant competition facing these firms may not be local, but international.

The analysis includes additional robustness tests to estimate the TFP of revenue variable properly. One key concern is that controlling for sector and metropolitan area fixed effects to account for local factors that may influence market power may not completely account for the simultaneous determination of supply and demand side variables.[5] The bias in the TFP of revenue estimation that remains can cause the estimated productivity of some firms to be high as a consequence of the associated price advantage, not solely because of the associated productivity. This implies that, in the presence of firm-level market power, the results here are a lower bound of the potential effects of changes in local industry concentration. To explore the extent to which this may be an issue, the analysis includes two robustness tests. First, the analysis produces a productivity measure through a robust estimation of the production function using a panel of firms in the 2009 and 2014 rounds of the economic census (Olley and Pakes 1996). This allows one to run a control on the endogeneity of inputs, correct for selection (exit), and deal with unobserved (quasi-)permanent differences across firms. Second, the analysis estimates the preferred model using the TFP of revenue from the five rounds of the census, but introduces as a control a measure of firm-level markup defined as revenues

[5] This should not be an issue in this study given that the marginal costs of firms should not be affected substantively by changes in local industry concentration. This distinguishes this study from other studies that examine the relationship between productivity and competition arising because of trade liberalization and that also consider changes in marginal costs caused by the potential reduction in inputs relevant for the production function of firms.

over total costs. The main results are shown to be robust to these two checks.

This paper represents an important contribution to the literature on this topic in developing countries because it takes advantage of microdata from several rounds of the establishment census to expand the limited evidence on the long-term dynamics between firm productivity and market concentration. Also, in contrast to the vast majority of previous studies that examine the relationship between competition and productivity driven by changes in external competition through trade liberalization, this study focuses on the productivity impacts of variations in local industry concentration, as well as the joint effect with international competition. The results also have important implications for the focus of policies aiming at improving productivity. Given the heterogeneity across the impacts of local industry concentration on productivity by subsector and by level of local exposure to international markets, it is important that government policies and investments be targeted on subsectors and regions that are less exposed to trade and more affected by a lack of local competition.[6]

The rest of the paper is organized as follows. Section 2 presents a brief literature review on the links between industry concentration and productivity. Section 3 describes the main sources of data and presents key stylized facts. Section 4 discusses the empirical strategy. Section 5 presents the main results, including heterogeneous effects and robustness checks. Section 6 concludes.

2. Literature review

The literature on endogenous growth shows that, in the standard model of endogenous technological change, there is a rent dissipation effect (Aghion and Howitt 1992; Romer 1986). This implies that increments of product market competition among intermediate producers reduce the expected future profits derived from innovation. However, Aghion et al. (2001) extend this basic framework to show that a positive relationship between market competition and growth might still exist in the case of an oligopolistic firm that uses innovation to shield itself from competition, at least temporarily. In this manner, incentives to innovate remain present and become stronger the closer a firm is to the technological frontier.[7] Thus, a positive relationship between product market competition and growth is not an unambiguous implication of theoretical work.

Most studies examining the relationship between competition and productivity focus on the aggregate level of productivity growth, but do not explore the effect on individual firms. With a few exceptions in developed economies, the latter research issue has received little attention on developing countries, and the lack of adequate data appears to be the main barrier to such studies (De Loecker 2011; Dunne, Klimek, and Schmitz 2008; Galindo, Schiantarelli, and Weiss 2005; Schmitz 2005).

[6] A future version of the results will include additional time-variant firm-level variables, such as access to international markets and the presence of foreign capital. These variables require additional visits to the Microdata Center that could not be performed before the publication of the current version of the document.

[7] It follows in the model of these authors that an increase in competition involves an innovation trade-off. The increase reduces monopoly rents, but enhances the incentive to innovate to escape the competition.

In one of the studies that rely on firm-level data, Nickell (1996) finds that competition, measured by higher numbers of competitors or by lower rents, is associated with higher TFP growth. He measures competition using a Lerner index, a price cost margin averaged across firms within an industry. This measure has several advantages over other indicators, such as market share or the Herfindahl concentration index, because the latter measures rely more directly on precise definitions of product and geographical markets. This is important because, in the case of the United Kingdom, many firms operate in international markets, meaning that market concentration measures based only on U.K. data are misleading. Similarly, Aghion et al. (2005) replicate Nickell's (1996) use of the Lerner index and combine it with policy changes to address the endogeneity between competition and innovation.[8] Their results show a positive effect of product market competition on productivity growth, particularly at low levels of competition.

Analyzing the effect of competition on productivity growth, Aghion, Braun, and Fedderke (2008) combine three data sets to compare product market competition in South African manufacturing firms and subsectors with corresponding firms and subsectors worldwide. They find that markups are significantly higher in South African industries than in the worldwide counterparts, leading to average profitability margins that are twice as large. These larger markups translate into a lower productivity growth rate. Back-of-the-envelope calculations reveal that a reduction in markups by 10 percent would lead to an increase in productivity growth of 2.0 percent to 2.5 percent a year. In a related study, Ospina and Schiffbauer (2010) capture competition pressure directly from the self-reported assessment of firm managers using the World Bank Enterprise Survey.[9] Estimating markups as sale prices over operating costs, the authors find that firms with markups that are 20 percent higher than the average have 1.2 percent lower TFP and 8 percent lower labor productivity.

If international competition on local markets is included, the literature shows that high levels of local concentration may not have a negative effect on productivity. Two mechanisms have been proposed to explain this outcome. First is self-selection: only the more productive firms engage in export activities and can compete internationally. Second is the learning-by-exporting hypothesis whereby firms that enter export markets gain access to the technical expertise of their buyers, which non-exporters do not have. The interaction with agents with more technical expertise allows exporter firms to improve their efficiency.

The self-selection hypothesis has been relatively easy to prove empirically (Alvarez and López 2005; Bernard and Jensen 1999; Clerides, Lach, and Tybout 1998; Van Biesebroeck 2005). However, the

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[8] The policy changes include Thatcher era privatizations, the European Union Single Market Programme, and the Monopoly and Merger Commission investigations that led to the imposition of structural or behavioral remedies on industry.

[9] The survey explicitly asks "How important is pressure from domestic competitors on key decisions about your business with respect to reducing the production costs of existing products or services?" The responses range from one to four, where one is less importance, and four is more importance.

evidence on the learning-by-exporting hypothesis has been less clear-cut because the detailed information required to isolate the changes that occur within a firm starting to export is lacking. One exception is the identification strategy used by De Loecker (2007), who takes advantage of the massive entrance of Slovenian firms into export markets in 1994–2000. De Loecker is able to identify the instantaneous and future productivity gains at export entry. Based on matching sampling techniques to control for self-selection into export markets and an Olley and Pakes (1996) procedure to estimate productivity, his results reveal that new export firms become more productive. Indeed, the productivity gap widens over time and is higher among firms exporting to higher-income regions. In a more highly controlled setting, Atkin, Khandelwal, and Osman (2017) find similar results by running a randomized experiment to generate exogenous variation in the access to foreign markets among rug producers in the Arab Republic of Egypt. They find large gains in quality as well as a rise in profits of between 16 percent and 26 percent.

3. Data and stylized facts on market concentration and economic productivity

Economic census data

The analysis here uses detailed establishment-level data from Mexico's economic census collected every five years by the national statistics office, the National Institute of Statistics and Geography. The census measures the economic activity of private establishments in fixed locations. It collects information on firm sales, value added, number of workers, types of contractual arrangements, labor remuneration, and value of fixed capital. One of the objectives of this paper is to learn about the joint effect of international competition and high levels of concentration. For this reason, although the database covers all nonagricultural activity, the paper focuses on manufacturing because it is one of the sectors that were affected the most by the export promotion strategy. The paper uses five rounds of the census run in 1994, 1999, 2004, 2009, and 2014. Only the census rounds of 2009 and 2014 allow the construction of a panel of firms.

In 2014, the census was used to collect information from around 4 million private establishments; of these, around 11 percent were in manufacturing. At the 3-digit level, the census divides the manufacturing sector into 21 industry types.[10] The final sample in this analysis relies on 20 economic subsectors after excluding firms in petroleum and coal products; this subsector is excluded because of its need for large, localized capital investments by a few firms. The preferred sample relies on information on 229,865 establishments in 2014; a detailed list of the number of manufacturing establishments per subsector, at the 3-digit level, may be found in Annex A, Table A.1.

[10] The latest round of the census follows the North American Industry Classification System. In this paper, the codes used in previous rounds have been converted into this classification.

Estimation of the production function and trends in the TFP of revenue

A Cobb-Douglas production function is used to estimate productivity at the firm level.[11] Given the data available, we used as inputs for the production function of each firm i, the logarithms of total capital, labor measured as the number of employees, and the total cost of inputs. In the main specification, fixed effects for year (t), metropolitan area (r), and subsector (j) are also included. Equation (1) is estimated for the logarithms of value added and total sales.

$$\ln(y_{i,t}) = \beta_0 + \beta_1 \ln(capital_{i,t}) + \beta_2 \ln(Labor_{i,t}) + \beta_3 \ln(Inputs_{i,t}) + Year_t + Region_r + Sector_j + \epsilon_{i,t} \; (1) \qquad (1)$$

As is thoroughly explored in the literature, a double causality exists between input selection and unobserved productivity variables: more productive firms choose higher-quality inputs and combine them in a more efficient way relative to less efficient firms. Moreover, this productivity determines the probability of exit of a firm during following periods. This endogeneity can still be present after the inclusion of fixed effects.

If possible, the analysis solves for this endogeneity problem by implementing an Olley and Pakes (1996) correction. This transformation only requires a monotonic relationship between a firm-level decision variable and the unobserved firm-level state variable, productivity. However, the economic census only allows one to construct a panel of firms from the censuses of 2009 and 2014. When all the census rounds are used, year, metropolitan area, and sector fixed effects are included to account as best as possible for the relationship between input choice and productivity, as well as unobserved market conditions that affect the level of productivity of firms.

Table 1 shows trends in the TFP by subsector at the 3-digit level within manufacturing using the 1994 economic census as base year. Only a few subsectors exhibit a reduction in aggregate productivity calculated at the national level: wood products, paper, nonmetallic mineral products, and computer and electronics. Nonetheless, during the period, trends in manufacturing productivity were stagnant. A similar story is revealed in Figure 1, which shows that there is a substantial gap in productivity between the top and bottom performers across industries and metropolitan areas. In some subsectors, the gap appears to be widening over time (Levy 2018).

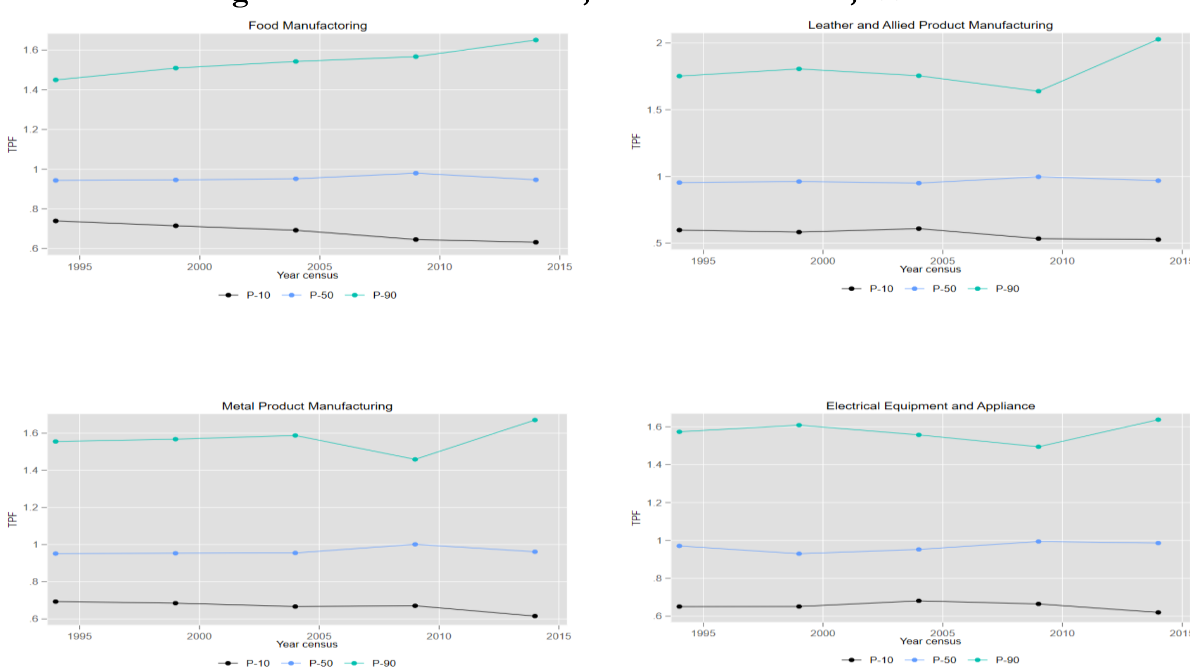
[11] Results using a translog production function will be implemented in a future iteration of the paper, but no changes are expected in any of the paper's main conclusions.

Table 1. Evolution of TFP, by manufacturing industry subsector, Mexico

Subsector	*Evolution of TFP by subsector, 1994 base year*				*Descriptive statistics*	
	1999	*2004*	*2009*	*2014*	*Avg.*	*SD*
Food manufacturing	0.985	0.980	0.982	1.046	1.092	1.468
Beverage and tobacco product manufacturing	1.000	0.958	0.983	1.074	1.152	1.289
Textile mills	1.009	1.085	0.995	1.049	1.158	1.604
Textile products mills	0.921	1.046	0.989	1.053	1.166	1.247
Apparel manufacturing	0.982	0.985	0.991	1.054	1.202	1.122
Leather and allied manufacturing	0.996	0.958	0.888	1.043	1.190	1.216
Wood products	0.965	0.964	0.934	0.961	1.092	0.816
Paper manufacturing	1.006	0.986	0.964	0.950	1.118	1.102
Printing and related support activities	0.998	1.001	0.980	1.002	1.086	0.611
Chemical manufacturing	0.913	0.909	0.897	0.921	1.115	1.923
Plastic and rubber products	1.018	1.020	1.005	1.078	1.105	1.890
Nonmetallic mineral products manufacturing	1.014	1.011	0.977	1.008	1.098	0.661
Primary metal manufacturing	0.982	0.981	0.946	1.003	1.095	0.642
Fabricated metal products	1.002	1.001	0.976	1.040	1.084	0.707
Machinery manufacturing	0.964	0.973	0.949	1.036	1.092	0.992
Computer and electronics	1.089	1.043	1.042	1.067	1.101	0.635
Electrical equipment, appliance, and components	0.998	1.000	0.984	1.010	1.093	0.634
Transport equipment	1.023	1.019	1.040	1.279	1.171	4.218
Furniture and related products	0.991	0.974	0.954	1.005	1.091	0.693
Miscellaneous manufacturing	0.931	0.940	0.898	0.934	1.114	1.063

Source: Calculations based on the economic census.
Note: The TFP at the firm level was calculated using equation (1). Data are aggregated at the 3-digit subsector level using the firm share of subsector employment. Avg. = average. SD = standard deviation.

Figure 1. Trends in the TFP, selected industries, 1994–2014

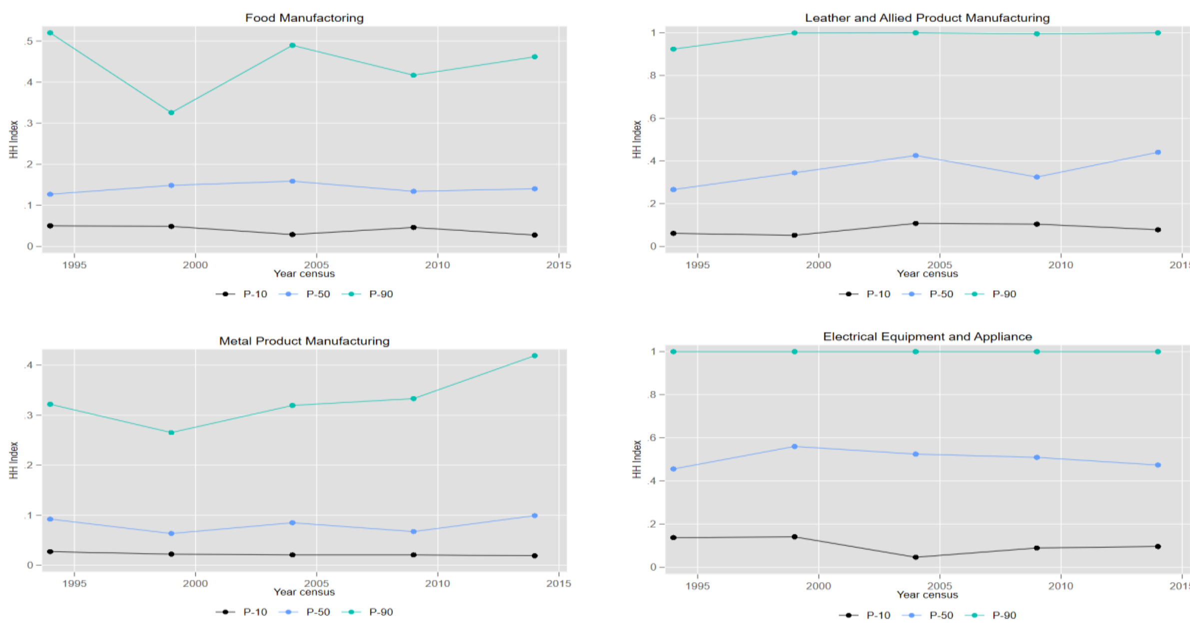


Source: Calculations based on the Mexican manufacturing census.
Note: Only selected subsectors are shown. The panels show the percentiles of the TFP in selected subsectors.

The dynamics of industry concentration

To measure local industry concentration, the analysis uses the 54 metropolitan areas defined by the National Population Council in 2000.[12] The analysis constructed several concentration indexes at the metropolitan area level; these include the HHI based on total sales, as well the share of total production generated by the five largest firms.[13] Figure 2 shows concentration, based on the HHI, at the metropolitan area level for a selected group of industries. During the period studied, there were substantial changes in relative terms and wide differences across industries and regions.[14] The variations are wider if the data are analyzed at the metropolitan area level. Figure 3 shows how, in each subsector, the concentration at the metropolitan area level evolved. In 11 of the 20 total subsectors, the median HHI increased.

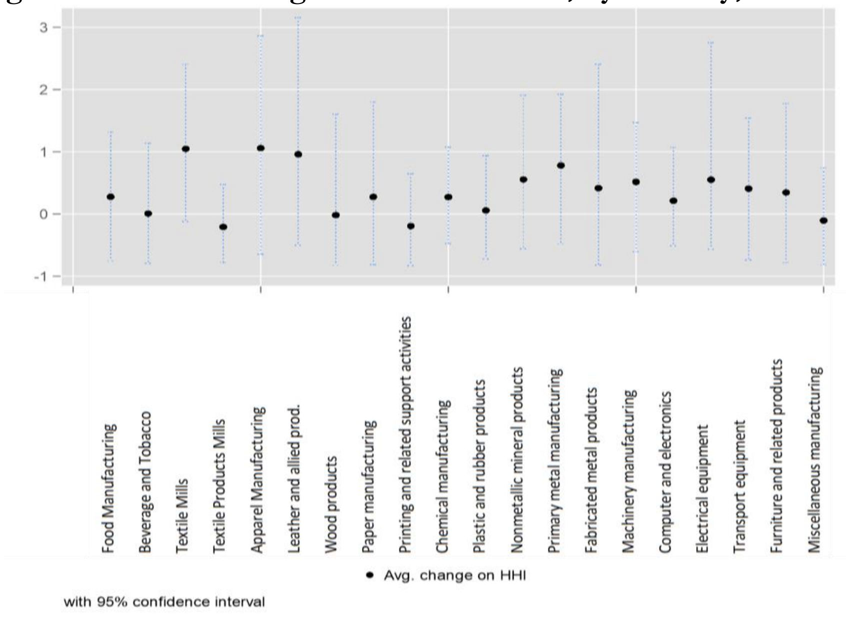
Figure 2. Trends in the HHI at the metropolitan area level: selected industries, 1994–2014



Source: Calculations based on the Mexican manufacturing census.
Note: Only selected subsectors are shown.

[12] The National Population Council's definition of metropolitan areas included 55 areas in 2000. During the period of study, additional metropolitan areas were created but are not included in the study. A metropolitan area is defined as a group of two or more municipalities in which a city with a population of at least 50,000 is located; this urban area extends over the limit of the municipality that originally contained the core city and incorporated, physically or under its area of direct influence, other, adjacent, predominantly urban municipalities, all of which have a high degree of social and economic integration. The definition also includes municipalities that, given their characteristics, are relevant for the development of urban planning policies. Additionally, a metropolitan area is defined for those municipalities with a million or more inhabitants, as well as those cities with 250,000 inhabitants that share urban processes with cities in the United States. Annex B presents the total number of manufacturing companies by metropolitan area in 1994–2009.
[13] The data in Mexico do not allow the calculation of a markup Lerner index because the prices of inputs are not available.
[14] See the online annex for the results on all industries.

Figure 3. Relative change in the HHI index, by industry, 1994–2014



Source: Calculations using Mexican manufacturing census.
Note: The HHI index was created using the total value of production of each manufacturing establishment recoded in the census. Outliers with changes higher than 10 were not included.

Trade and external exposure data

For the years of analysis, 2004, 2009, and 2014, a control is introduced for the level of external exposure of metropolitan areas to international markets. Data from the Mexico Atlas of Economic Complexity are used to test how well exposure to international markets eliminates the negative effects of market concentration on productivity.[15] This instrument facilitates an understanding of economic patterns and the productive ecosystems at a relatively small geographical location. The Atlas of Economic Complexity is the best approximation available on local trade patterns. It contains estimations of the amount of exports and imports at a 3-digit sub-sectoral level that are demanded or generated from each metropolitan area at the location. It uses as raw data the customs registries that cover all transactions independently of their destination and then assigns the data to municipalities.

Most exports in Mexico are produced in metropolitan areas (Table 2). This is expected because metropolitan areas account for most of the formal economic activity. The analysis thus relies on the fact that there is little external competition in the remaining municipalities of the country.

[15] See "Mexico Atlas of Economic Complexity," Growth Lab, Center for International Development, Harvard University, Cambridge, MA, https://growthlab.cid.harvard.edu/mexico-atlas-economic-complexity.

Table 2. Share of exports produced in metropolitan areas, 2004–14

	2004	2009	2014
Food Manufacturing	97.10%	97.47%	97.58%
Beverage and Tobacco Product Manufacturing	99.92%	99.92%	99.80%
Textile Mills	80.28%	90.16%	91.07%
Textile Products Mills	97.17%	96.62%	97.45%
Apparel Manufacturing	87.61%	87.41%	86.54%
Leather and allied manufacturing	97.42%	95.73%	90.58%
Wood products	98.07%	98.25%	98.85%
Paper manufacturing	95.63%	95.34%	96.13%
Printing and related support activities	93.12%	98.43%	99.08%
Chemical manufacturing	95.76%	98.56%	98.67%
Plastic and rubber products	97.25%	94.51%	92.63%
Nonmetallic mineral products manufacturing	88.38%	93.50%	92.57%
Primary metal manufacturing	97.19%	90.24%	92.92%
Fabricated metal products	89.87%	92.19%	93.05%
Machinery manufacturing	95.21%	96.47%	96.20%
Computer and electronics	94.41%	95.05%	94.54%
Electrical equipment, appliance and components	95.11%	93.30%	94.88%
Transport equipment	100.00%	99.81%	96.99%
Furniture and related products	98.40%	92.78%	95.67%
Miscellaneous manufacturing	97.41%	97.77%	90.09%

Source: Calculations based on the Mexico Atlas of Economic Complexity.

4. Empirical strategy

To study the effects of competition on economic productivity in Mexico, the analysis regresses the level of 3-digit sub-sectoral concentration (approximated by the HHI) for every metropolitan area against the level of productivity of each firm located in the relevant metropolitan area. As controls, the estimated model includes the share of each subsector at the 3-digit level and the change in the number of firms at the same level of disaggregation. To account for unobservable time invariant characteristics that affect each subsector annually, year and subsector-specific fixed effects are also included. Annex A.2 shows descriptive statistics on the concentration measures used in the regressions.

The analysis estimates the effect of market concentration on productivity in manufacturing. Equation (2) describes the model estimated. The variable $HHI_{r,j,t}$ denotes the concentration level for industry j, in metropolitan region r, in a given year t. Fixed effects are included to account for sub-sectoral and metropolitan area-specific shocks. However, they limit the number of controls that can be used in the regression. As controls, the sub-sectoral share of total production value in each region is included, as well as the percent change in the total number of firms in each region and subsector. These controls are included to account for the sub-sectoral importance in the overall activity of the economic region.

The inclusion of controls and fixed effects in equation (2) is not sufficient to establish the causal relationship between concentration and productivity. The issue is that local market concentration in each industry may not be exogenous, and it may thus be correlated with other characteristics that affect the concentration level of the industry in a given metropolitan area. For example, initial levels of concentration in a metropolitan area may affect local government incentives and the local resources that are demanded in the same subsector.

$$\text{TFP}_{i,j,t} = \beta_0 + \beta_1 HHI_{r,j,t} + \sum_{q=2}^{3} \beta_q X_{r,j,t} + Year_t + Sector_j + region_r + \epsilon_{i,t} \quad (2)$$

To circumvent this concern about potential reverse causality from the endogenous sorting of firms across metropolitan areas, the analysis implements a Bartik (2002) instrument strategy. The instrument predicts the concentration level in a metropolitan area by applying national changes in the sub-sectoral concentration in each industry, using as base year the 1994 concentration levels, which are arguably exogenous, for the rest of the analysis. By keeping constant the concentration level across metropolitan areas at the level of 1994, the analysis forecloses the possibility that specific local policies or resources might determine future changes in local levels of concentration.[16] By design, the instrument cannot be influenced by selection into metropolitan areas. Rather, it isolates the component of change in the local concentration that is driven by national trends, such as changes in national trade policies, industry-specific incentives, the competitive environment, or the labor market. Moreover, the instrumental variable procedure isolates the industry-specific characteristics and the market structures that determine a natural concentration level. In this way, the total change in concentration in a geographical area *j* can be divided into an exogenous component recreated using the instrument and deviations from the predicted change. In this manner, the instrument allows only the exogenous source of variation to be used (for instance, see Boustan et al. 2008).

Formally, the instrument is defined for each subsector in a specific metropolitan area at period *T*, as follows:

$$IV_{HHI_{r,j,T}} = HHI_{r,j,t=0} \times g_{j,T}^{national} \quad (3)$$

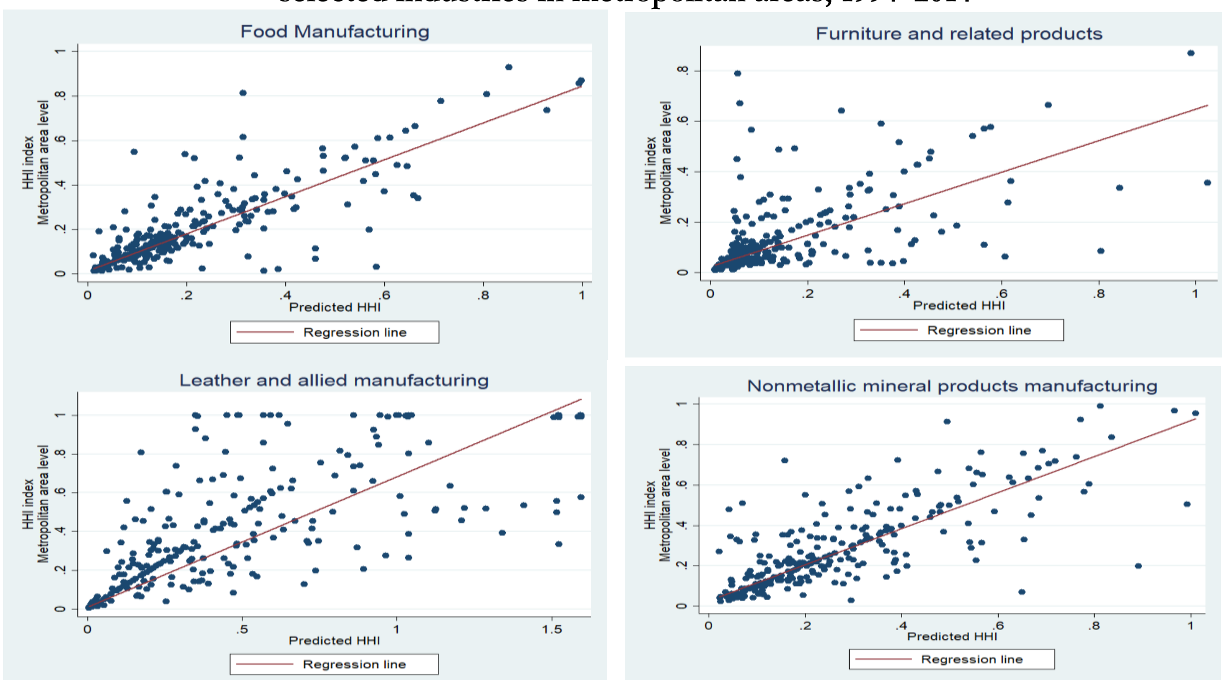
where $HHI_{r,j,t=0}$ is the concentration in subsector *j* in the metropolitan area in the first economic census available, while $g_{j,T}^{national}$ represents the growth rate, of the concentration variable, for the same subsector *j* nationwide between period $t = 0$ and T. There is wide variation in the concentration across metropolitan areas. During the construction of the instrument, however, the resulting shares differ from the observed data. This is in line with the fact that the instrument does not simply follow the trends observed in the data. Areas with high concentration in a specific subsector at the beginning of the period did not drive the trends in changes nationwide as other areas became proportionally more concentrated in the observed data.

There is a strong, positive relationship between the two measures, suggesting that much of the change in local industry concentration in 1994–2014 was driven by national trends rather than local factors. Figure 4 shows the results of the first-stage regression between actual and predicted HHI index

[16] Alternative estimation strategies might include focusing only on the impact of the entrance of China into the World Trade Organization. This strategy relies on measuring the exposure of Mexico to external competition coming from China and using a Bartik (2002) approach to control for the exposure of Mexican sectors to other international competitors.

coefficients in selected subsectors. Further tests show that the trends in the changes in productivity are not correlated with the initial concentration levels, a key identification assumption.

Figure 4. First-stage regression: relationship between actual and counterfactual HHI, selected industries in metropolitan areas, 1994–2014



Source: Calculations using Mexican manufacturing census.

5. Main results: Market concentration lowers productivity

The main results show a negative and statistically significant relationship between concentration and economic productivity. This result holds and becomes more pronounced following the instrumental variables strategy, confirming that, in the absence of instrumental variables, one would underestimate the true effect of local industry concentration on productivity (Table 3).[17] All the results hold if other measures of concentration are used. In the preferred specification, a reduction of 10 points in local industry concentration implies an economically meaningful increase of 1 percent in the TFP of revenue.[18]

[17] In exploratory work, the analysis also finds a nonlinear effect of concentration on productivity if a quadratic term on the effect of the HHI is included. This nonlinearity is indicative that, as the concentration increases, total productivity falls, but at a lower rate, reflecting a competition and innovation trade-off. This trade-off is caused by oligopoly rents on innovation that enhance the incentive to innovate to escape competition, but, as the pressure of competition disappears, the incentives to innovate also dwindle, as developed by Aghion and Howitt (1992) and Romer (1986).

[18] The impact depends on the sector and specific metropolitan area where the pro-competitive change takes place; we explore sector heterogeneity in the next section.

Table 3. Effects of market concentration on economic productivity, manufacturing, 1994–2014

Indicator	*Productivity*			
	(1)	*(2)*	*(3)*	*(4)*
HHI	−0.074***	−0.069***	−0.075***	−0.097***
	(0.003)	(0.003)	(0.004)	(0.005)
Constant	1.069***	1.070***	1.059***	1.052***
	(0.001)	(0.001)	(0.001)	(0.002)
Partial R-squared	NA	NA	NA	0.4938
Kleinbergen-Paap statistic	NA	NA	NA	684,055
Controls	No	Yes	Yes	Yes
Year fixed effects	No	No	Yes	Yes
Sector fixed effects	No	No	Yes	Yes
Instrumental variables	No	No	No	Yes
Observations	867,126	687,356	687,356	687,224
R-squared	0.001	0.001	0.001	0.002

Note: Standard errors are shown in parentheses.
*** p < .01 ** p < .05 * p < .1

Heterogeneous effects, by industry

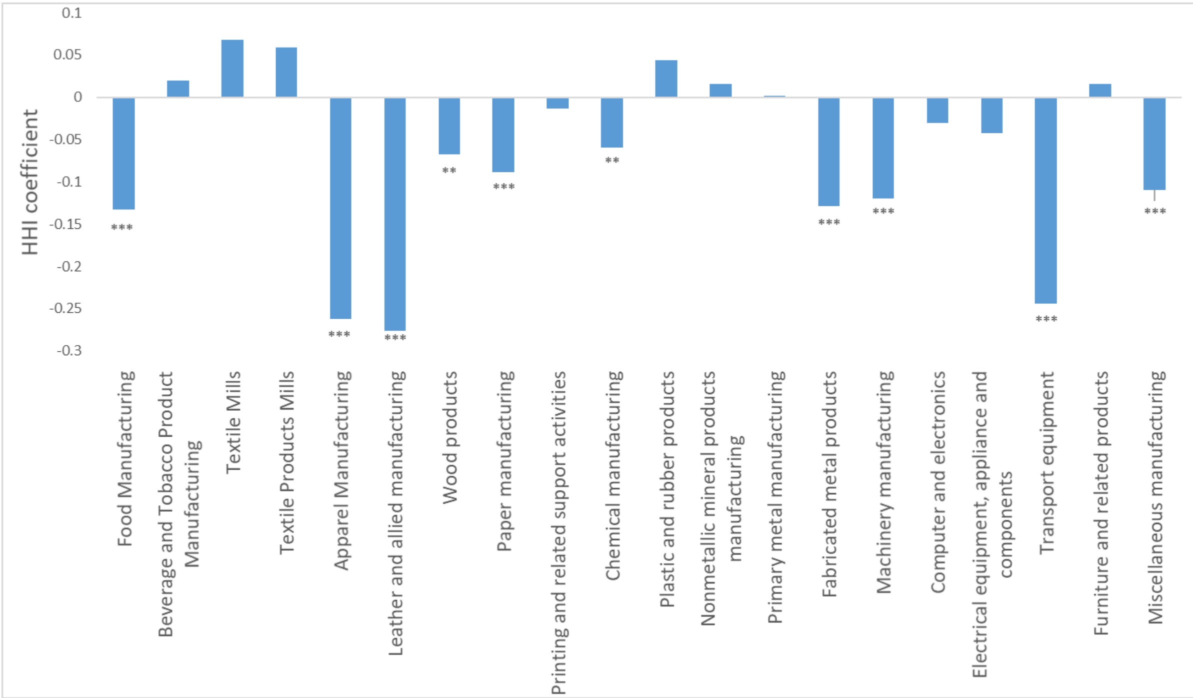
A source of heterogeneity—hidden in the regressions shown in Table 3—is how differences in technologies in each industry affect the impact of concentration on productivity. To study this effect, the analysis estimated equation (2) at the sectoral level. Figure 5 shows a negative and statistically significant impact of concentration on productivity in 10 of 20 subsectors, and non-statistically significant effects in all other sectors. [19]

The magnitude of these coefficients varies by subsector. Table 4 shows the economic impacts in all the subsectors that present a statistically significant result. The results indicate that, in the case of leather manufacturing, the subsector with the greatest impact, a reduction of 0.1 standard deviation in the concentration measure implies an increase of almost 0.07 standard deviation in productivity of the sector. Exploring the characteristics that determine that specific sectors respond differently to concentration is a topic that requires further research. Possible explanations include sector-specific capital-to-labor ratios that favor concentration and competition from close substitutes.[20] The analysis focuses on the former by exploring how exposure to international markets changes the incentives that keep a concentrated industry competitive.

[19] After implementing a Holm correction to account for the family-wise error rate, the analysis finds no evidence for false rejection because of multiple hypothesis testing.

[20] The petroleum and coal products industries are not included in the results of this paper given the low number of establishments and the industry's geographical concentration. The low number of establishments seriously dampens the capacity to reach significant conclusions about the subsector.

Figure 5. Effects of market concentration on economic productivity at the 3-digit category



Source: Calculations based on the economic census.
*** p < .01 ** p < .05

Table 4. Economic significance, by subsector

Sector	*Economic Significance*
Food Manufacturing	-0.016
Apparel Manufacturing	-0.048
Leather and allied manufacturing	-0.071
Wood products	-0.014
Paper manufacturing	-0.025
Chemical manufacturing	-0.009
Fabricated metal products	-0.028
Machinery manufacturing	-0.040
Transport equipment	-0.018
Miscellaneous manufacturing	-0.022

Source: Calculations based on the economic census.
Note: Preferred specification used: instrumental variable.

Heterogeneous effects of exposure to international markets

The analysis explored whether the effects of concentration on productivity are somewhat neutralized if the relevant market of manufacturing firms is the international market, an analysis that is also new at this level of empirical rigor in developing-country contexts. The analysis takes advantage of data from the Atlas of Economic Complexity to measure subsector-specific exposure to international markets in each metropolitan area. The preferred measure of exposure to international markets is the share of total exports in each subsector that are produced in each metropolitan area. This variable has an important level of variation that is useful in estimating how exposure to international markets acts to offset the negative effects of local concentration. Even if the average share is similar across subsectors, there is a high level of dispersion among metropolitan areas (Table 5).

Table 5. Average share of exports from each metropolitan area

	Mean	*Median*	*sd*	*max*	*min*
Food Manufacturing	1.80%	0.28%	0.044	32%	0%
Beverage and Tobacco Product Manufacturing	1.85%	0.00%	0.073	64%	0%
Textile Mills	2.29%	0.42%	0.041	21%	0%
Textile Products Mills	1.80%	0.13%	0.042	26%	0%
Apparel Manufacturing	1.61%	0.19%	0.036	20%	0%
Leather and allied manufacturing	1.88%	0.12%	0.037	22%	0%
Wood products	1.82%	0.05%	0.080	65%	0%
Paper manufacturing	1.83%	0.18%	0.040	22%	0%
Printing and related support activities	1.79%	0.22%	0.064	49%	0%
Chemical manufacturing	1.88%	0.23%	0.054	38%	0%
Plastic and rubber products	1.79%	0.13%	0.033	16%	0%
Nonmetallic mineral products manufacturing	1.69%	0.15%	0.043	35%	0%
Primary metal manufacturing	2.21%	0.32%	0.040	23%	0%
Fabricated metal products	1.70%	0.10%	0.033	17%	0%
Machinery manufacturing	1.89%	0.13%	0.034	22%	0%
Computer and electronics	2.93%	0.10%	0.064	31%	0%
Electrical equipment, appliance and components	2.28%	0.04%	0.045	21%	0%
Transport equipment	1.98%	0.04%	0.049	30%	0%
Furniture and related products	1.77%	0.07%	0.058	44%	0%
Miscellaneous manufacturing	1.76%	0.03%	0.055	38%	0%

Source: Calculations based on the economic census.
Note: Max = maximum. Min = minimum. SD = standard deviation.

Several measures of exposure may be constructed for this study. The analysis relies on the share of exports in each subsector produced in each metropolitan area. This variable reflects how competitive the manufactures in each metropolitan area are relative to other areas. Possible reasons for differential levels of productivity may include how close an area is to the border with the United States or to important ports, levels of human capital, and the effects of agglomeration. An alternative variable for this analysis that is usually proposed is the import share of each subsector in each metropolitan area. The analysis did not rely on this variable, as it is difficult to account for the share of imports entering a metropolitan area that is used as intermediate goods.[21]

The analysis estimates the model described in equation (2) at the firm level. It uses the share of total exports in each subsector that are produced in each metropolitan area, r, at time t. To study how exposure to international markets alters the negative effect of concentration on productivity, the

[21] Estimating the model of equation (2) using the import share does not change the results qualitatively.

analysis interacts the variable of exposure with the concentration that is used above, as follows:

$$\text{TFP}_{i,t} = \beta_0 + \beta_1 HHI_{r,t} + \beta_2 exportshare_{r,t} + \beta_3 exportshare_{r,t} * HHI_{r,t} + \sum \beta_j X_{r,t} + Year_t + Sector_j + Region_r + \epsilon_{i,t} \quad (4)$$

Table 6 illustrates that concentration has a negative impact on productivity. However, as the share of exports widens, this effect is neutralized. For instance, the results in column (3) suggest that, at a certain level of local competition, more exposure to external markets will cancel the negative effect of market concentration on productivity. Given the magnitude of the interaction coefficient, one would expect that substantial exposure to external markets would completely cancel and even revert the negative effect of the lack of local competition.

Table 6. Joint effect of concentration and exposure to external markets on manufacturing productivity, Mexico, 1994–2014

Indicator	*(1)*	*(2)*	*(3)*
HHI	−0.089***	−0.085***	−0.086***
	(0.004)	(0.004)	(0.004)
Share exports		0.002	0.003
		(0.003)	(0.004)
Share exports * HHI		0.831***	0.880***
		(0.089)	(0.094)
Constant	1.070***	1.071***	1.073***
	(0.001)	(0.001)	(0.001)
Controls	No	Yes	Yes
Fixed effects	No	No	Yes
Observations	557,163	441,478	441,478
R-squared	0.001	0.001	0.001

Source: Calculations based on the economic census.
Note: Standard errors are shown in parentheses.
*** p < .01 ** p < .05 * p < .1

If the estimation is expanded to obtain subsector-specific results, one finds that, of 20 subsectors, 9 exhibit an interaction between exposure to international markets and concentration. The interaction is positive and statistically significant. Two subsectors have a coefficient for the interaction term that is negative. Nonetheless, the concentration and exposure to international market coefficients both have the expected sign. Three subsectors have a positive and statistically significant coefficient on the concentration term (Table 7).[22]

[22] These subsectors are textile mills, furniture products, and electrical equipment. If one does not account for the role of exposure to international markets, the first two subsectors present positive, but not significant coefficients for the concentration variable.

Table 7. Subsector productivity effects, concentration and international market exposure

	HHI		*Share exports*		*Share exports * HHI*		*Obs.*	*R-squared*
Food Manufacturing	-0.102***	(0.008)	0.141***	(0.019)	-2.885***	(0.493)	158,321	0.003
Beverage and Tobacco Manufacturing	-0.003	(0.019)	-0.006	(0.086)	-0.128	(0.356)	17,144	0.005
Textile Mills	0.125*	(0.071)	0.309*	(0.176)	-1.164	(1.310)	1,914	0.028
Textile Products Mills	0.014	(0.052)	-0.087	(0.218)	1.151	(1.093)	5,284	0.004
Apparel Manufacturing	-0.108***	(0.030)	0.640***	(0.082)	-2.511**	(1.037)	24,594	0.009
Leather and allied manufacturing	-0.199***	(0.049)	-0.159	(0.120)	1.767	(1.110)	13,749	0.008
Wood products	-0.083***	(0.027)	0.029	(0.122)	0.875	(1.428)	18,845	0.001
Paper manufacturing	-0.030	(0.045)	0.254**	(0.122)	3.004***	(0.668)	3,687	0.013
Printing and related support activities	-0.056*	(0.030)	0.010	(0.019)	1.756***	(0.584)	28,987	0.001
Chemical manufacturing	-0.084**	(0.037)	-0.044	(0.058)	4.135*	(2.403)	5,942	0.002
Plastic and rubber products	-0.017	(0.040)	0.020	(0.101)	4.338***	(1.251)	9,061	0.002
Nonmetallic mineral manufacturing	0.008	(0.023)	0.267***	(0.085)	3.253***	(1.225)	23,875	0.008
Primary metal manufacturing	-0.066	(0.061)	-0.127	(0.331)	1.099	(0.981)	1,666	0.003
Fabricated metal products	-0.039***	(0.013)	0.076**	(0.036)	3.912***	(0.501)	76,622	0.002
Machinery manufacturing	-0.053	(0.047)	0.113	(0.213)	3.855***	(1.336)	4,005	0.007
Computer and electronics	-0.028	(0.086)	0.261	(0.260)	-0.352	(1.827)	1,111	0.053
Electrical equipment and appliances	0.192***	(0.066)	1.500***	(0.266)	-3.033	(2.562)	1,952	0.031
Transport equipment	-0.219***	(0.044)	-1.261***	(0.246)	1.633***	(0.614)	3,250	0.032
Furniture and related products	0.054*	(0.030)	0.219***	(0.077)	0.560	(0.666)	28,145	0.002
Miscellaneous manufacturing	-0.111***	(0.029)	-0.123	(0.103)	4.749***	(1.464)	13,324	0.006

Source: Calculations based on the economic census.
Note: Coefficients are displayed horizontally. Regressions include metropolitan area fixed effects. Obs. = observations.

The economic impact of the interactions term depends on the values of the concentration and export share associated with each industry. Table 8 displays the economic significance of increases in the exposure to international markets while the concentration of the subsector in the economic area is held fixed. One may see that greater exposure to international markets is able to offset and, in most cases, reverse the negative effects of concentration on productivity.[23]

[23] For example, an increase of one standard deviation in the exposure to international markets increases productivity by 0.1 standard deviation in the chemical subsector.

Table 8. Economic significance of exposure to international markets at the subsector level

Subsector	*Economic significance*
Food manufacturing	−0.035
Textile mills	0.018
Apparel manufacturing	0.028
Paper manufacturing	0.022
Printing and related support activities	0.048
Chemical manufacturing	0.099
Plastic and rubber products	0.010
Nonmetallic mineral products manufacturing	0.064
Fabricated metal products	0.065
Machinery manufacturing	0.220
Electrical equipment, appliance and components	0.073
Transport equipment	−0.013
Furniture and related products	0.002
Miscellaneous manufacturing	0.041

Source: Calculations based on the economic census.
Note: A subsector is displayed only if the results are statistically significant.

Robustness tests

Olley and Pakes bias correction

The first robustness test involves accounting for the possibility that the estimation of the productivity of each firm is still biased after the inclusion of region, subsector, and year fixed effects. The correction methods developed in the literature on industrial organization for this endogeneity problem, particularly the Olley and Pakes (1996) method, require the use of a panel at the firm level. In the case of the Mexican economic census, this method was applied only for the last two rounds (2009 and 2014), since these are the only years with a firm-level panel structure.

Table 9 compares changes in the coefficients of the regression used to estimate the TFP under three estimation techniques: Olley and Pakes (1996), simple regression with no controls, and simple regression with year and sector fixed effects. As column (3) shows, the coefficients used above to predict firm-level TFP are, in general, close to the ones obtained after using the correction technique. The main results are also robust if a measure of firm-level markup, defined as revenues over total costs, is introduced as a control (Annex C).

Table 9. TFP estimation according to selected methodologies

Indicator	*Olley and Pakes (1996)* (1)	*Simple regression* (2)	*Year and subsector fixed effects* (3)
Capital	0.043***	0.041***	0.040***
	(0.001)	(0.001)	(0.001)
Expenditure	0.848***	0.853***	0.850***
	(0.000)	(0.001)	(0.001)
Labor	0.155***	0.154***	0.162***
	(0.002)	(0.002)	(0.002)
Proxy	0.045***		
	(0.003)		
Year fixed effects	No	No	Yes
Sector fixed effects	No	No	Yes
Firm fixed effects	No	No	No
Observations	115,802	115,802	115,802
R-squared		0.971	0.964

Note: Standard errors are shown in parentheses.
*** p < .01 ** p < .05 * p < .1

Next, we repeat the analysis of the impact of local concentration on productivity using the corrected productivity measure. As data limitations mean that only the last two rounds of the census can be used, Table 10 shows both the estimation in the subsample with and without applying the Olley and Pakes correction. In both cases, even if the magnitude of the effect changes, the direction and significance are comparable. . Given that both coefficients are statistically significant, it is not possible to determine, in this smaller sample, the extent to which the unobserved firm markup captured by the residual of equation (1) is turning the results reported here into a lower bound of the true impact of concentration.

Table 10. Olley and Pakes correction: effects of market concentration on manufacturing productivity, Mexico, 2009–14

	(1)	*(2)*
TFP corrected, Olley and Pakes (1996)	Yes	No
HHI	−0.104**	−0.117***
	(0.043)	(0.009)
Constant	2.405***	−0.006**
	(0.013)	(0.003)
Controls	Yes	Yes
Year fixed effects	Yes	Yes
Sector fixed effects	Yes	Yes
Observations	90,457	90,457
R-squared	0.010	0.005

Note: Standard errors are shown in parentheses.
*** p < .01 ** p < .05 * p < .1

Extending the results on the role of the exposure to international markets using the sample of the last two censuses, Table 11 shows that the negative effect of concentration persists, However, when applying the Olley and Pakes (1996) correction, the coefficient for the effect of concentration becomes statistically insignificant. The effect of the share of exports is positive and counterbalances a negative coefficient for the interaction of the share of exports and concentration. This result can be interpreted as how a reduction in the level of concentration still increases productivity, conditional on a given level of export share.

Table 11. Olley and Pakes correction: the joint manufacturing productivity effect of concentration and exposure to external markets, Mexico, 2009–14

	(1)	*(2)*
TFP corrected, Olley and Pakes (1996)	Yes	No
HHI	0.007	−0.058***
	(0.041)	(0.009)
Share exports	0.460***	0.240***
	(0.078)	(0.017)
Share exports * HHI	−4.906***	0.234
	(0.852)	(0.185)
Constant	2.371***	−0.030***
	(0.012)	(0.003)
Controls	Yes	Yes
FE	Yes	Yes
Observations	115,802	115,802
R-squared	0.011	0.005

Note: Standard errors are shown in parentheses.
*** $p < .01$ ** $p < .05$ * $p < .1$

Robustness to the use of other concentration measures

The analysis also explored the productivity impact of other concentration measures at the metropolitan area level. Table 12 explores this effect using, as a measure of concentration, the share of the five biggest firms in the metropolitan area in their respective subsectors. In general, all the results hold.

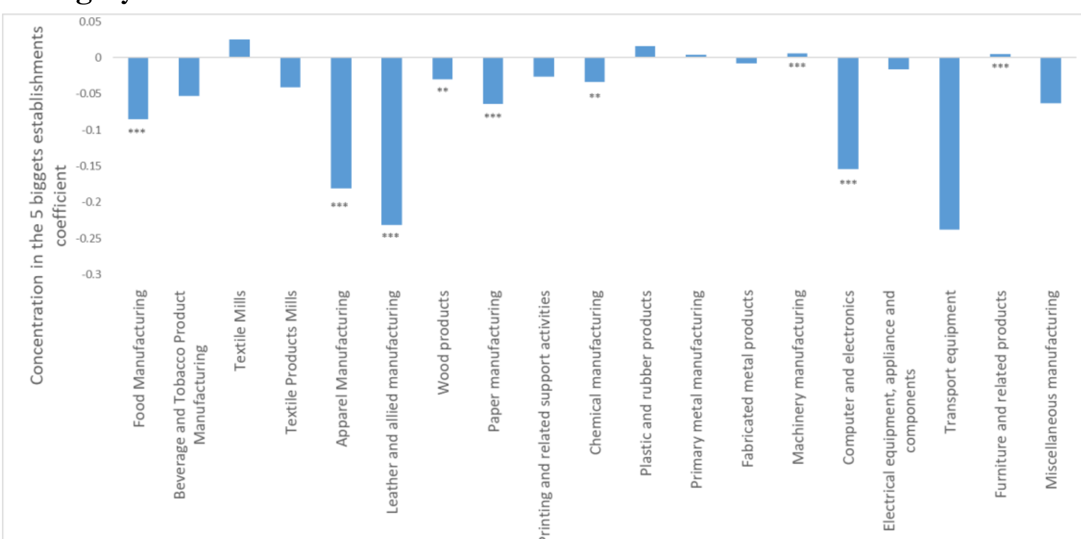
As with the previous results, the analysis finds heterogeneous effects at the industry level (Figure 6). The effects are negative in the same subsectors as in the previous results. The results present a similar pattern if one calculates the economic impact: concentration has a negative and economically significant impact in eight subsectors. Considering the stagnant levels of productivity growth in the country, understanding the factors that create this negative impact and the factors that can be used to mitigate the negative impact are a first-order policy question.

Table 12. Manufacturing productivity effects of market concentration using alternative independent variables, Mexico, 1993–2014

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Simple				Quadratic			
HHI	−0.052***	−0.047***	−0.053***	−0.062***	−0.115***	−0.099***	−0.071***	−0.022
	(0.002)	(0.002)	(0.002)	(0.003)	(0.009)	(0.010)	(0.011)	(0.019)
Constant	1.085***	1.085***	1.075***	1.071***	1.098***	1.096***	1.079***	1.063***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)
Controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes
FE year	No	No	Yes	Yes	No	No	Yes	Yes
FE Sector	No	No	Yes	Yes	No	No	Yes	Yes
IV	No	No	No	Yes	No	No	No	Yes
Observations	867,126	687,356	687,356	687,218	867,126	687,356	687,356	687,218
R-squared	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.002

Note: Standard errors are shown in parentheses.
*** p < .01 ** p < .05 * p < .1

Figure 6. Effect on productivity measured by the total output of the five biggest firms, at the 3-digit category



Source: Calculations based on the economic census.

6. Conclusion: Concentration reduces productivity, but trade exposure matters

The economic literature has seen a proliferation of both theoretical and empirical studies aimed at estimating the effects of various factors on productivity, such as openness to trade, access to credit, innovation, and factor misallocation. Some studies have focused on the effects of industry concentration on firm productivity, but most of these correspond to developed countries or have ignored the role of external competition. By using information on five rounds of the economic census in Mexico and accounting for potential issues of double causality, this paper finds evidence of a negative relationship between industry concentration and economic productivity. This main result, however, varies significantly by subsector of economic activity within the manufacturing sector. The analysis shows that the negative effects of local industry concentration on firm productivity are statistically significant and of greater magnitude in 10 of the 20 subsectors at the 3-digit level, which represents about 72 percent of the total export value in manufacturing of Mexico. However, these results must be interpreted with caution, since additional evidence on the factors that drive sector-specific impacts is beyond of the scope of this paper and thus requires further analysis.

This study also finds that the potential negative effects of market concentration on productivity are neutralized and, depending on the sector, reversed if exposure to external markets exists. This may be interpreted as evidence that local market concentration mostly affects economic productivity if the relevant demand for the firms is domestic. These results suggest that programs seeking to boost productivity in developing countries should foster firm entry, thereby enhancing industry competition, in those sectors and geographical areas that are more highly exposed to international trade.

The results have important implications for public policy, particularly in middle-income countries with low levels of economic competition and less exposure to external markets, because these countries may be experiencing a double negative effect on economic productivity. Thus, policies that aim to reduce the cost of entry for new firms, combined with the promotion of trade, will be the most effective in boosting productivity in manufacturing in these countries. Considering the current level of tariffs, the evidence would suggest that these policies should aim to reduce the legal entry barriers for domestic competition. The results are in line with those of Atkin, Khandelwal, and Osman (2017), in that firms that are more highly exposed to external markets are also more productive.

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Annex A. Manufacturing subsectors, 3-digit level, Mexico

Table A.1. Total establishments per year, preferred sample, 1994–2014

Sector code	*Industry*	*1994*	*1999*	*2004*	*2009*	*2014*	*Total*
311	Food manufacturing	43,624	57,158	60,478	70,535	79,690	311,485
312	Beverage and tobacco product manufacturing	1,649	2,002	3,728	7,903	11,367	26,649
313	Textile mills	1,759	1,937	1,040	1,201	874	6,811
314	Textile product mills	1,362	1,946	1,813	3,449	3,425	11,995
315	Apparel manufacturing	12,161	14,748	10,779	15,674	12,397	65,759
316	Leather and allied product manufacturing	5,626	8,070	4,804	7,478	7,192	33,170
321	Wood product manufacturing	3,891	7,269	7,540	9,109	8,626	36,435
322	Paper manufacturing	1,149	1,962	1,805	2,306	2,531	9,753
323	Printing and related support activities	11,051	11,882	11,421	14,396	15,013	63,763
325	Chemical manufacturing	2,081	3,396	2,468	3,230	3,424	14,599
326	Plastics and rubber products manufacturing	2,672	4,581	3,878	4,231	4,765	20,127
327	Nonmetallic mineral product manufacturing	11,991	15,296	11,641	13,344	12,780	65,052
331	Primary metal manufacturing	1,081	1,546	976	785	677	5,065
332	Fabricated metal product manufacturing	23,533	29,645	28,372	36,529	38,842	156,921
333	Machinery manufacturing	1,702	1,981	2,030	1,887	1,854	9,454
334	Computer and electronic product manufacturing	1,179	670	612	581	599	3,641
335	Electrical equipment, appliance, and component manufacturing	1,277	1,281	799	1,014	967	5,338
336	Transportation equipment manufacturing	871	1,777	1,529	1,597	1,634	7,408
337	Furniture and related product manufacturing	9,591	13,663	10,519	13,317	15,611	62,701
339	Miscellaneous manufacturing	2,401	5,301	5,258	7,877	7,597	28,434

Source: Calculations based on the economic census.

Table A.2. Variables used in regressions: concentration and controls, 1999–2014

Variables	*Average values*			
	1999	*2004*	*2009*	*2014*
Concentration				
Food manufacturing	0.19	0.21	0.20	0.20
Beverage and tobacco product manufacturing	0.51	0.53	0.49	0.40
Textile mills	0.60	0.59	0.55	0.60
Textile products mills	0.46	0.39	0.32	0.29
Apparel manufacturing	0.19	0.20	0.24	0.24
Leather and allied manufacturing	0.42	0.50	0.45	0.45
Wood products	0.16	0.16	0.16	0.14
Paper manufacturing	0.54	0.49	0.37	0.36
Printing and related support activities	0.13	0.16	0.16	0.14
Chemical manufacturing	0.45	0.49	0.46	0.45
Plastic and rubber products	0.39	0.46	0.39	0.38
Nonmetallic mineral products manufacturing	0.27	0.31	0.28	0.27
Primary metal manufacturing	0.60	0.62	0.65	0.65
Fabricated metal products	0.12	0.13	0.14	0.17
Machinery manufacturing	0.49	0.49	0.56	0.52
Computer and electronics	0.49	0.60	0.54	0.51
Electrical equipment, appliance and components	0.59	0.54	0.56	0.53
Transport equipment	0.44	0.45	0.50	0.54
Furniture and related products	0.11	0.15	0.13	0.14
Miscellaneous manufacturing	0.28	0.25	0.22	0.22
Controls				
Sectoral share, total production value, each region	0.061	0.068	0.063	0.066
Number of firms in each region, sector (% change)	0.019	−0.065	0.327	0.4356

Source: Calculations based on the economic census.

Annex B. Total number of manufacturing companies, number, Mexico

Table B.1. Number of manufacturing companies, by metropolitan area, 1994–2009

Metropolitan area	*1994*	*1999*	*2004*	*2009*
Aguascalientes	2,697	2,983	2,894	3,560
Chihuahua	2,161	2,300	1,792	2,334
Juárez	2,272	2,782	2,400	2,310
Valle de México	45,809	57,036	54,257	65,031
Moroleón-Uriangato	858	1,862	1,329	2,166
León	5,665	8,734	6,991	8,904
San Francisco del Rincón	696	1,231	924	1,572
Acapulco	1,203	2,060	1,890	2,681
Pachuca	1,017	1,378	1,267	2,063
Tulancingo	602	867	810	1,003
Tula	459	641	752	979
Tijuana	2,197	2,694	2,514	2,934
Guadalajara	11,011	17,568	15,129	17,572
Ocotlán	538	713	776	818
Puerto Vallarta	426	609	604	851
Toluca	2,720	4,644	4,854	8,181
Zamora-Jacona	618	771	869	1,067
LaPiedad	451	626	646	786
Morelia	2,486	2,995	3,187	3,997
Cuautla	841	1,140	1,346	1,785
Cuernavaca	2,025	2,806	2,934	3,885
Tepic	1,015	1,328	1,214	1,717
Monclova-Frontera	676	832	782	1,217
Monterrey	8,211	10,827	9,468	11,005
Oaxaca	1,974	3,603	2,974	4,248
Puebla-Tlaxcala	9,996	13,094	11,045	15,502
Querétaro	1,726	2,252	2,266	3,225
Cancún	817	1,081	1,033	1,489
Rioverde-Ciudad Fernández	320	468	413	456
San Luis Potosí-Soledad	2,712	3,495	3,091	4,111
Guaymas	394	475	483	763
Villahermosa	1,111	1,574	1,516	1,752
Piedras Negras	264	284	295	425
Tampico	1,715	2,021	1,871	2,327
Matamoros	690	902	918	1,273
Nuevo Laredo	493	756	749	644
Reynosa-RíoBravo	898	1,178	1,227	1,738
Apizaco	499	775	800	1,127
Tlaxcala	1,070	1,692	1,512	2,421
Acayucan	302	379	401	459
Coatzacoalcos	654	907	973	1,189
Minatitlán	508	808	908	1,064
Córdoba	713	977	1,005	1,272
Saltillo	1,955	2,236	1,940	2,484
Xalapa	1,521	2,140	1,967	2,351
Orizaba	912	1,681	1,309	1,656
PozaRica	1,511	1,544	1,398	1,468
Veracruz	1,497	1,945	1,693	1,967
Mérida	3,338	3,220	2,987	3,944
Zacatecas-Guadalupe	697	897	785	1,140
LaLaguna	2,885	3,250	2,961	3,407
Colima-VilladeÁlvarez	856	909	948	1,192

Source: Calculations based on the economic census.

Annex C. Robustness check, controlling by markups defined as revenues over costs

Table C.1. Local industry concentration and productivity, controlling by firm-level markups, 1994–2014

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
HHI	−0.086***	−0.086***	−0.083***	−0.084***	−0.105***	−0.106***	−0.129***	−0.129***
	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)	(0.015)	(0.015)
Markup		0.003***		0.003***		0.002***		0.002***
		(0.000)		(0.000)		(0.000)		(0.000)
Constant	1.116***	1.110***	1.110***	1.104***	1.113***	1.107***	1.096***	1.091***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)	(0.005)	(0.005)
Controls	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	No	No	No	Yes	Yes	Yes	Yes
Sector fixed effects	No	No	No	No	Yes	Yes	Yes	Yes
IV	No	No	No	No	No	No	Yes	Yes
Observations	884,823	881,146	701,265	698,323	701,265	698,323	701,127	698,188
R-squared	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.002
Subsectors, number					20	20		

Note: Standard errors are shown in parentheses.
*** p < 0.01, ** p < 0.05, * p < 0.1